Amendments to the Claims

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

Claim 1 (Currently Amended): A phase contrast system for synthesizing [[an]] a desired output electromagnetic field u(x", y", z"), comprising:

a first phase modifying element for phase modulation of an input electromagnetic field by phasor values $e^{i\phi(x,y)}$,

first Fourier or Fresnel optics, for Fourier or Fresnel transforming the phase modulated electromagnetic field, positioned in a propagation path of the phase modulated electromagnetic field,

a spatial filter for filtering the Fourier or Fresnel transformed electromagnetic field by,

in a region of spatial frequencies comprising DC in a Fourier or Fresnel plane,

phase shifting with a predetermined phase shift value θ the Fourier or Fresnel transformed electromagnetic field in relation to a remaining part of

the Fourier or Fresnel transformed electromagnetic field, and

multiplying an amplitude of the phase shifted transformed electromagnetic field with a constant *B*, and

in a region of remaining spatial frequencies in the Fourier or Fresnel plane,

multiplying an amplitude of the Fourier or Fresnel transformed electromagnetic field with a constant *A*,

second Fourier or Fresnel optics, for forming an electromagnetic field o(x', y') by Fourier or Fresnel transforming the filtered electromagnetic field, and

a second phase modifying element for phase modulating the electromagnetic field o(x', y') into an electromagnetic field o(x', y')$e^{i\Psi(x', y')}$ propagating as the desired output electromagnetic field $u(x'',y'',z'')$.

Claim 2 (Currently Amended): A phase contrast system according to claim 1, wherein at least one of the first and second phase modifying elements is further adapted for phase modulation by first phasor values for a first polarization <u>of the input electromagnetic field</u> and second phasor values for a second orthogonal polarization of the input

electromagnetic field.

Claim 3 (Previously Presented): A phase contrast system according to claim 2, wherein the second phase modifying element is adapted for phase modulation by the first phasor values $e^{i\Psi 1(x', y')}$ for the first polarization and the second phasor values $e^{i\Psi 2(x', y')}$ for the second orthogonal polarization of the input electromagnetic field.

Claim 4 (Currently Amended): A phase contrast system according to claim 2 [[3]], further comprising an element for directing the phase modulated first polarization of the input electromagnetic field and the second orthogonal polarization of the input electromagnetic field ~~modified orthogonal electromagnetic fields~~ into separate paths of propagation, to be applied in a non-interfering counter-propagating geometry.

Claim 5 (Previously Presented): A phase contrast system according to claim 1, wherein

$$A = 1.$$

Claim 6 (Previously Presented): A phase contrast system according to claim 1, wherein

B = 1.

Claim 7 (Previously Presented): A phase contrast system according to claim 1, wherein

$\theta = \pi$.

Claim 8 (Currently Amended): A phase contrast system according to claim 1, wherein the phasor values $e^{i\phi(x,y)}$ of the first phase modifying element and the phase shift value θ substantially fulfil that

$$o(x',y') \cong A\left[\exp\left(i\tilde{\phi}(x',y')\right) + K\left|\overline{\alpha}\right|\left(BA^{-1}\exp(i\theta) - 1\right)\right]$$

wherein

A is an optional amplitude modulation of the spatial filter outside a zero-order diffraction region,

B is an optional amplitude modulation of the spatial filter in the zero-order diffraction region,

$\overline{\alpha} = \left|\overline{\alpha}\right|\exp\left(i\phi_{\overline{\alpha}}\right)$ is an average of the phasor values $e^{i\phi(x,y)}$ of resolution elements of the

first phase modifying element, and

$\tilde{\phi} = \phi - \phi_{\bar{\alpha}}$, and

$K = 1 - J_0(1.22\pi\eta)$, wherein

J_0 is a zero-order Bessel function and

η relates a radius R_1 of [[a]] the zero-order ~~filtering~~ diffraction region to a radius R_2 of a main-lobe of an Airy function of an input aperture of the first phase modifying element,

$\eta = R_1 / R_2 = (0.61)^{-1} \Delta r \Delta f_r$,

wherein Δr is a radius of ~~a circular~~ the input aperture of the first phase modifying element and Δf_r is a spatial frequency range of the zero-order diffraction region.

Claim 9 (Previously Presented): A phase contrast system according to claim 8, wherein the phase shift value θ substantially fulfills the equation

$$K|\bar{\alpha}| = \frac{1}{2|\sin\theta/2|}.$$

Claim 10 (Previously Presented): A phase contrast system according to claim 1,

wherein at least one of the first and second phase modifying elements comprises a complex spatial electromagnetic field modulator that is positioned in a path of the input electromagnetic field and comprises modulator resolution elements (x_m, y_m), each of the modulator resolution elements (x_m, y_m) modulating a phase and an amplitude of the electromagnetic field incident thereon with a predetermined complex value $a_m(x_m, y_m)e^{i\varphi(xm, ym)}$.

Claim 11 (Previously Presented): A phase contrast system according to claim 1, further comprising a light source for emission of the input electromagnetic field, the light source comprising a laser array, such as a VCSEL array.

Claim 12 (Previously Presented): An optical micro-manipulation or multi-beam optical tweezer system including the phase contrast system of claim 1.

Claim 13 (Previously Presented): A laser machining tool including the phase contrast system of claim 1.

Claim 14 (Currently Amended): A method of synthesizing [[an]] <u>a desired</u> output electromagnetic field u(x", y", z"), comprising:

phase modulating an input electromagnetic field by phasor values $e^{i\phi(x,y)}$,

Fourier or Fresnel transforming the phase modulated electromagnetic field,

filtering the Fourier or Fresnel transformed electromagnetic field by,

in a region of spatial frequencies comprising DC in a Fourier or Fresnel plane,

phase shifting with a predetermined phase shift value θ the Fourier or Fresnel transformed electromagnetic field in relation to a remaining part of the Fourier or Fresnel transformed electromagnetic field, and

multiplying an amplitude of the phase shifted transformed electromagnetic field with a constant *B*, and

in a region of remaining spatial frequencies in the Fourier or Fresnel plane,

multiplying an amplitude of the Fourier or Fresnel transformed electromagnetic field with a constant *A*,

forming an electromagnetic field o(x', y') by Fourier or Fresnel transforming the

filtered electromagnetic field, and

phase modulating the electromagnetic field o(x', y') into an electromagnetic field o(x', y')$e^{i\Psi(x', y')}$ propagating as the desired output electromagnetic field $u(x'', y'', z'')$.

Claim 15 (Currently Amended): A method according to claim 14, further comprising:

dividing the electromagnetic field o(x',y') into pixels in accordance with disposition of resolution elements (x, y) of a first phase modifying element having a plurality of individual resolution elements (x, y), each resolution element (x, y) modulating a phase of electromagnetic radiation incident thereon with a predetermined phasor value $e^{i\phi(x,y)}$,

calculating the phasor values $e^{i\phi(x,y)}$ of the <u>first</u> phase modifying element and the <u>predetermined</u> phase shift value θ substantially in accordance with

$$o(x', y') \cong A\left[\exp\left(i\tilde{\phi}(x', y')\right) + K\left|\overline{\alpha}\right|\left(BA^{-1}\exp(i\theta) - 1\right)\right]$$

wherein

A is an optional amplitude modulation of a spatial [[phase]] filter <u>used in said filtering and</u> outside a zero-order diffraction region,

B is an optional amplitude modulation of the spatial [[phase]] filter in the zero-order diffraction region,

$\bar{\alpha} = |\bar{\alpha}| \exp\left(i\phi_{\bar{\alpha}}\right)$ is an average of the phasor values ~~phasors~~ $e^{i\phi(x,y)}$ of the resolution elements of the first phase modifying element, and

$\tilde{\phi} = \phi - \phi_{\bar{\alpha}}$, and

$K = 1 - J_0\left(1.22\pi\eta\right)$, wherein

J_0 is a zero-order Bessel function, and

η relates a radius R_1 of the [[a]] zero-order ~~filtering~~ diffraction region to a radius R_2 of a main-lobe of an Airy function of [[the]] an input aperture of the first phase modifying element, $\eta = R_1 / R_2 = (0.61)^{-1} \Delta r \Delta f_r$,

wherein Δr is a radius of the ~~a circular~~ input aperture of the first phase modifying element and Δf_r is a spatial frequency range of the zero-order diffraction region,

selecting, for each resolution element, one of two phasor values which represent a particular grey level, and

supplying the selected phasor values $e^{i\phi(x,y)}$ to the respective resolution elements (x, y) of the first phase modifying element, and

supplying selected phasor values $e^{i\psi(x',y')}$ to respective resolution elements (x', y') of a second phase modifying element having a plurality of individual resolution elements (x', y'), each resolution element (x', y') modulating a phase of electromagnetic radiation incident thereon with the respective phasor values [[value]] $e^{i\psi(x',y')}$ for generation of the ~~output~~ electromagnetic field $o(x', y')e^{i\Psi(x', y')}$.